

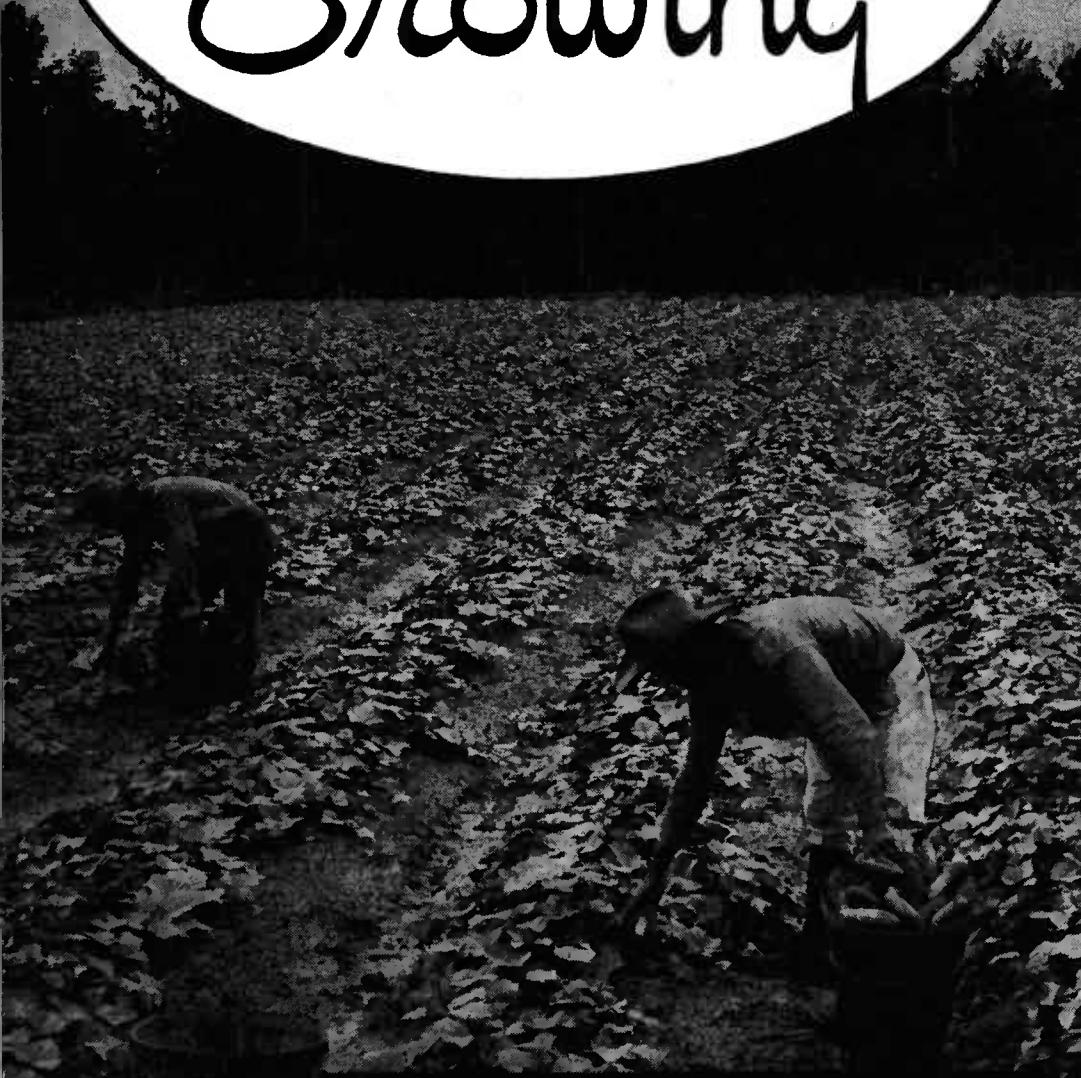
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# Cucumber Growing



FARMERS' BULLETIN No. 1563  
U.S. DEPARTMENT OF AGRICULTURE

**T**ABLE OR SLICING CUCUMBERS are grown for the market in 25 States, but the main carlot movements originate in 12 States.

The markets are now well supplied, and the present outlook for table-cucumber consumption in the United States does not warrant any great expansion of acreage.

Average gross returns from field-grown table cucumbers during the period from 1928 to 1938 were less than \$100 an acre; the average production cost was approximately \$80 an acre.

The forcing of early-spring cucumbers in coldframes has become a highly specialized industry, mainly in the Norfolk, Va., district.

The market requirements are for cucumbers that are fresh, crisp, of medium size, dark green in color, clean, and uniformly graded.

This bulletin contains cultural directions for growing table or slicing cucumbers in coldframes and as a field crop. For information on the production of cucumbers in greenhouses the reader is referred to Farmers' Bulletin 1320 and for growing cucumbers for pickling, to Farmers' Bulletin 1620.

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# CUCUMBER GROWING

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## IMPORTANCE OF THE INDUSTRY

CUCUMBERS are included among the 20 important commercial truck crops that are shipped to the markets of the United States in large quantities. The area planted to cucumbers for table purposes in 1940 was 42,870 acres, and the crop produced was valued at \$4,993,000, as reported by the Crop Reporting Board, Division of Agricultural Statistics, Agricultural Marketing Service. This acreage is exclusive of approximately 91,000 acres of cucumbers grown for pickles and also of the crop produced in greenhouses. This bulletin deals only with the production of table or slicing cucumbers as a field crop and those grown in coldframes, or under sash, during the early part of the season.

Fresh or table cucumbers are grown for carlot shipment in 25 States, large quantities being grown in 12 of them. Florida was the largest shipper in 1940, having shipped 1,268 of a total of 2,712 carlots shipped by the entire cucumber-producing territory. The shipment of cucumbers to the larger markets is divided into three seasonal periods—early, intermediate, and late. The early-shipping section includes Alabama, California, Florida, Georgia, North Carolina, South Carolina, Texas (southern portion), and Virginia (Norfolk district, where cucumbers are grown under sash). The intermediate-shipping territory includes Delaware, southern Illinois, Maryland, Ohio, and New Jersey. New York is the outstanding State in the production of late cucumbers, but Louisiana, Georgia, Michigan, and Wisconsin ship at the same time.

Florida ships during two seasons of the year; the first season includes October, November, and December; and the second, April, May, and June, May being the heaviest shipping period for this State. Ship-

ments from South Carolina, Louisiana, Virginia, and the southern part of California follow or overlap those from Florida.

For table or slicing cucumbers as a salad vegetable there is a fairly good demand, especially during the spring and early-summer months. Although they do not form one of the major vegetable crops grown in the United States, their production is a source of considerable farm income. The growing of high-grade table cucumbers is rather difficult, owing mainly to the prevalence of insects and diseases that must be overcome by spraying and by other special methods. The forcing of early-spring cucumbers in coldframes has become a highly specialized industry, mainly in the Norfolk, Va., district.

Average gross returns from field-grown table cucumbers during the period from 1928 to 1938 were less than \$100 an acre; the average production cost was approximately \$80 an acre. Despite the fact that yields and prices increased during the 5-year period 1936-40, the production of cucumbers as a field crop has been only reasonably profitable. There were intervals in this period during which the markets were temporarily overstocked, and prices therefore were low.

The present outlook for table-cucumber consumption in the United States does not warrant any great expansion of acreage, but there is need for more intensive culture and the production of higher grade table stock. This is particularly true of the sections where the crop is grown in the field, as the frame industry leaves little to be desired in the way of quality of product or intensity of cultural practices. It is estimated that there are about 150 acres in the Norfolk district devoted to the growing of cucumbers under sash. This industry has developed since about 1906, and on the whole has been fairly profitable. At present, however, production costs are so heavy that the sash growing of cucumbers is rather hazardous; in fact, only the best growers claim to be making any money. Gross returns from an acre of frames range from \$1,000 to \$2,000 for the cucumber crop alone, but high production costs very greatly offset these large returns.

The growing of cucumbers under sash is essentially a modification of intensive field culture by which the hazards of early planting are largely eliminated through the use of greenhouses for starting the plants and of coldframes for growing the crop to an advanced stage. This system has the advantage of greatly lengthening the season, considerable quantities of cucumbers being marketed before the outdoor crop is much more than planted. In some instances the frame-grown plants continue to produce until midsummer and after the field crop has been plowed under.

## SOILS AND FERTILIZERS

Cucumbers can be grown on almost any good soil. The commercial crop, however, is produced largely on the sandy loams of the Gulf coast and Atlantic coast regions. A soil consisting of from 14 to 18 inches of dark sandy loam overlying a close sand or medium clay subsoil is ideal, especially if the natural water level of the area is within 8 or 10 feet of the surface, thus insuring an ample supply of subsoil moisture. The intensive hotbed and coldframe crop of the Norfolk district is produced on highly fertilized sandy loam. In Florida and elsewhere in the Atlantic and Gulf coast regions the field crop is grown by the aid of considerable quantities of commercial

fertilizers. In order to avoid diseases, it is essential that cucumbers be grown in long-period rotations and on new land or on that which has not been used for any of the related crops for at least the preceding 3 or 4 years. Good drainage, together with moisture-holding power, is essential in soils on which cucumbers are to be grown.

Even where considerable manure is available, one or more of the soil-improvement crops should be included in the rotation, and these should be turned under to enrich the soil and add humus. Where a winter cover crop is grown on the land it will be necessary to turn it under at least 2 or 3 weeks in advance of planting. Where only a limited quantity of manure is available, it can be used to best advantage if it is placed in furrows underneath the rows; or if the plants are



FIGURE 1.—Fertilizing cucumber beds in the Norfolk, Va., district during early December.

to be grown in hills, the manure can be mixed with the soil composing the hills. In field culture the manure is sometimes applied by means of a manure spreader in a narrow strip where the rows are to be located. In the Wilmington, N. C., district, cucumbers follow early spring lettuce, the cucumber crop in turn being followed by soil-improvement crops. In Florida, velvetbeans are largely used as a soil-improvement crop.

The frame-cucumber growers of the Norfolk-Portsmouth, Va., district usually grow a crop of soybeans, sorghum, rye, or cowpeas on their land during the late summer and turn these crops under for soil improvement. They also apply 70 to 100 tons of manure to the acre each year. The manure is first thoroughly composted, and a portion of it is spread upon the beds during the early winter, as shown in figure 1. A week or two in advance of setting the cucumbers the remainder of the manure is placed in a furrow through the middle of the beds and is completely mixed with the soil by means of a one-horse cultivator before the ground is rebedded for planting.

Commercial fertilizers containing 4 to 5 percent of nitrogen, 8 to 10

percent of phosphoric acid, and 4 to 5 percent of potash are applied broadcast at the rate of 1 ton to the acre by most southern cucumber growers. In outdoor culture the entire 2,000 pounds is sometimes applied before planting; in other cases only about 1,200 pounds is applied in advance and the remainder is used in the form of side dressings during the growing period. In frame culture about 2 tons of high-grade commercial fertilizers are applied during the season; one-half is worked into the soil in advance of planting the crop, and the remainder is used as side dressings during the growing season. As a rule, a crop of early beets is grown on the land in the spaces between the cucumber beds, and additional fertilizers are applied to the beets.

Nitrate of soda is frequently used as a stimulant for both the frame-grown and the field-grown cucumber crops during the growing season, applications of 100 to 200 pounds per acre being made by turning back the vines and drilling or broadcasting the nitrate along the rows. In some cases a small furrow is opened, into which the nitrate is scattered; the furrow is then turned back in place. The frame-cucumber growers of the Norfolk district frequently dissolve the nitrate of soda in the tanks from which water is drawn for watering the plants in the beds. The nitrate is placed in the tank and the water stirred until all the nitrate is dissolved and uniformly mixed. The plants are then given a moderate watering with this solution, which greatly stimulates their growth. The nitrate should be used at a rate not exceeding 50 pounds to each 7,000 or 8,000 gallons of irrigation water. Complete fertilizers containing as much as 7 to 10 percent of readily available nitrogen are frequently used for side dressings, on both the field and the frame cucumber crops, instead of nitrate of soda or other form of readily available nitrogen, without the addition of phosphoric acid and potash. When dissolved in the irrigation water, nitrate of soda seems to give the quickest response, but for permanent results many growers prefer to use a complete fertilizer.

The fertilizer requirements of cucumbers depend to a considerable degree upon the supply of organic matter in the soil and especially on the extent to which this matter is derived from animal manures. In southern field culture, where little manure is available, a combination of soil-improvement crops and commercial fertilizers is relied upon to meet the plant-food requirements of the cucumber crop. In view of the fact that high-grade fertilizer ranges in price from \$30 to \$40 a ton, according to location and grade, which alone constitutes an important item in cucumber-production costs, and that the average returns from field-grown cucumbers are about \$100 an acre, the initial expenditure for fertilizer greatly reduces the ultimate profits. Gross returns from the specialized frame culture of cucumbers are of course much higher, thus justifying a greater expenditure for fertilizers.

## SOIL PREPARATION

Soils of the character on which cucumbers are usually grown are relatively easy to prepare. The more successful growers disk and harrow the land several times after plowing, in order that all the manure and fertilizers may be thoroughly mixed with the soil. The Norfolk frame-cucumber growers plow their land in the late fall, apply a heavy coating of manure, and disk the soil several times to work in the manure.

As the main considerations are earliness, quality, and a fairly long picking season, thorough preparation of the soil is essential, especially where production costs are high. The methods of soil preparation depend upon locality; for example, throughout the South Atlantic and Gulf Coast States the land is bedded, the height depending upon drainage conditions, and the seed is planted on top of the bed. In other sections the land is plowed and harrowed broadcast, the rows are marked off, and the seed is planted on the level or in a slight furrow. In sections where irrigation is practiced, the land is plowed in beds with irrigation furrows between, and the seed is planted just above the water level of the furrow.

Where a soil-improvement crop is grown during the late summer, it is plowed under before it is killed by frost. The land is then disked at intervals until November or December, when the manure is applied and the land again disked two or three times. The final preparation of the land begins about a month in advance of planting. In Florida soil preparation proceeds at any time during the late fall and early winter. The beds are thrown up somewhat higher than is required for planting and are then harrowed or dragged to a lower level, in many cases almost flat, before they are planted.

### VARIETIES

The white-spined type is most commonly grown in field culture (fig. 2). The newest strains are characterized by their dark-green color and the ability to retain this color during shipment. Probably the most popular in this group are Stays Green, or Black Diamond, and A and C. They are early and productive, range from 6 to 8 inches in length and from  $2\frac{1}{4}$  to  $2\frac{1}{2}$  inches in diameter at harvest, and are blocky or cylindrical in shape. Early Fortune, another white-spined shipping variety, is slightly longer and later maturing than the above-mentioned varieties and tapers slightly at both ends. Growers desiring a cucumber longer than Early Fortune should try Clark Special or Davis Perfect. Varieties longer than these are rarely successful when grown in the field.

Long Green is the only black-spined variety that is grown to any extent for slicing purposes.

### SEED SUPPLY

Too much stress cannot be placed on the importance of good seed. In view of the fact that less than 2 pounds of seed is required to plant an acre, the grower may well afford to pay a reasonably high price provided he is getting the quality represented. Certain seed houses are now meeting the demand for superior seed, in many cases treating the seed with organic mercury compounds to reduce the possibility of carrying to the fields any of the so-called seed-borne diseases. Cucumber seed retains its vitality from 3 to 5 years if kept under proper conditions of low moisture and uniform temperature. Reasonably fresh seed, however, is recommended. Many of the most successful cucumber growers have their own strains and save their seed from specially selected cucumbers. It is essential, however, that no cucumbers of inferior strain or of another variety be grown nearby, as bees are certain to carry the pollen and cause mixtures.

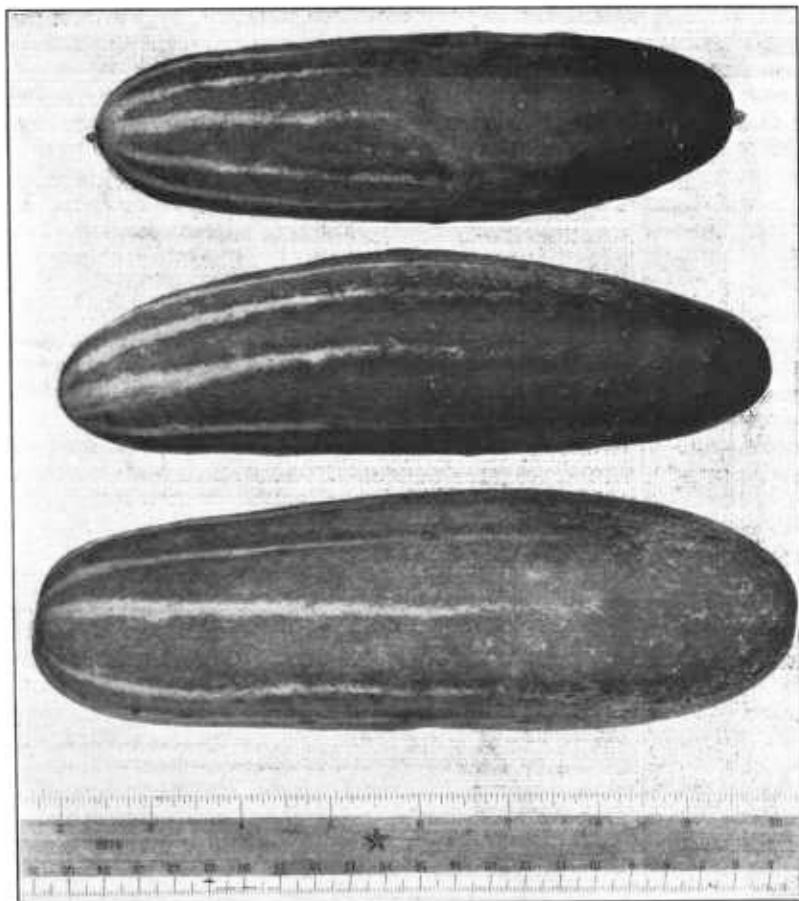


FIGURE 2.—Typical cucumbers of the white-spined type. The large specimen is overripe; the two smaller ones are about the right size for marketing.

### PLANTING THE FIELD CROP

Because cucumbers are susceptible to frost injury, planting in the field must necessarily be delayed until danger of frost is past. In some sections paper caps or covers are being used to protect the young plants, a week to 10 days being gained thereby in earliness of planting. As a general rule, however, it is not safe to put the seed in the ground until the soil is fairly warm. Some growers follow the practice of planting three lots of seed—the first about 10 days or 2 weeks before the date of the average last killing frost for the locality, the second about a week later, and the third after both the first and the second lot have appeared above the ground. If the first planting is not lost, it gives an extra-early crop. In some cases the first planting will be killed by frost and the second will come through the ground after the frost and form the basis for the crop. In a few instances both the first and the second planting are killed, in which case the third planting must be relied upon for a stand.

The final preparation of the soil usually consists of smooth harrowing or dragging just before planting the seed. In case of rain between the time of applying the fertilizer and planting, the land is given a light harrowing or dragging ahead of the planter. Many growers prefer to apply the fertilizer during this final preparation, in which case the work is done directly ahead of the planter.

Where the cucumbers are planted in hills the land is usually marked in both directions and the seed planted in the intersections. If the planting is in one direction only, the land is marked one way and the planter run in the mark. Frequently a marker is attached to the side of the planter and the land is marked and planted at one operation. Horse-drawn planters are used wherever the acreage is sufficiently large to warrant this, or an ordinary hand planter with a wheel in front is used. Care must be taken that the average planting machine does not put in too much seed.

Planting distances vary with the locality. Where the cucumbers are grown in hills, the hills are usually spaced 6 by 6 or 6 by 8 feet apart. When the planting is in rows, the rows are placed 4 to 8 feet apart and the plants thinned so that they stand 2 to 3 feet apart in the row. Wider spacing of rows and thinning to a single plant every 6 or 7 feet in the row has been found under most conditions to give better yields than are obtained by closer spacing. Cultivating, spraying, and picking are all made easier by wide spacing, and there is the suggestion that both insects and diseases may not be so troublesome where the vines do not mat together. Where the crop is grown in beds, the beds are generally 4 to 6 feet in width, the row being directly on top. In irrigated sections the row is placed on the south side of the bed and on the edge of the irrigation furrow, the seed being planted in hills. After the beds are made and the irrigation furrows opened, the water is admitted to the furrows to establish a level which serves as a guide in planting. The water is then shut off, and the seeds are planted in hills just above the water level. A second irrigation is frequently given to supply the moisture necessary to sprout the seeds.

Where cucumbers are planted in checks or hills, 9 to 12 seeds are placed in each hill by hand and covered about an inch deep, but if planted in rows, the seed is scattered thinly along the entire row. In planting in beds a slight furrow is opened through the middle of the bed, and the seed is planted in this furrow, or the seed drill is run in the middle of the bed. Cucumbers require thinning; as a rule 4 to 6 plants should be left in each hill at the first thinning, these being reduced to 2 or 3 plants after they have become well established. Where the cucumbers are planted in a continuous row, the initial thinning can be done with a hoe at the time of the first hand-hoeing, but the final thinning to a proper stand should be done by hand after the plants become well established.

## PROTECTION FROM COLD IN THE FIELD

Paper caps are sometimes used to protect the hills of cucumbers during the first week or 10 days in the field. These caps are put on as soon as the seed is planted and are kept over the young plants until danger of severe cold is over. Paper caps are not adapted for the protection of plants after they attain any considerable size.

In Florida the growers frequently use a protection consisting of two cypress boards nailed together in the form of a V-shaped trough. These troughs are turned over the rows of cucumbers at night and during extremely cold days, but in the daytime they are placed to one side of the row, where they serve as a windbreak for the plants (fig. 3). In order to derive the greatest benefit from wind protection, the rows are run at right angles to the direction of the prevailing winds. The troughs are placed during the day so that the young plants will gain the greatest benefit from the sunshine.

Small boxes without bottoms but covered by panes of glass are also used as protectors to some extent. The bulk of the field cucumber crop, however, is grown without special protection.



FIGURE 3.—Wooden troughs used for protecting young cucumber plants in Florida.

### CULTIVATION OF THE FIELD CROP

Cucumbers should be cultivated from the time the plants break through the ground, keeping the soil loose, mellow, and free from weeds until the spread of the vines makes further working impracticable. At first the cultivation may be fairly close to the hills and reasonably deep, but later, after the roots begin to spread, the cultivators should be run farther from the plants. It should be borne in mind that normally a cucumber is a comparatively shallow-rooted plant and that the roots often extend beyond the tips of the vines. It is therefore essential that, after the vines begin to run freely, cultivation should be relatively shallow and not too near the hills. Where the hills are carefully checked, cultivation can be carried on in both directions during the early part of the season. Weeders, one-horse cultivators, and riding cultivators are employed for working the crop. The vines are frequently turned back and the soil cultivated to a depth of about 2 inches even after the vines have made considerable growth. Hand-hoeing will be necessary early in the season while the plants are small. The thinning of the plants

in the hills is usually performed during the first and second hoeings. Light side dressings of nitrate of soda and of high-grade complete fertilizers are often applied just ahead of the third hand-hoeing and again during the final cultivation, the fertilizer being broadcast along the rows and worked into the soil by the cultivator.

After the vines cover the ground no further cultivation can be given, but it is sometimes necessary to go through and pull out weeds that are gaining a foothold. The vines of about every seventh row are usually turned back to form a space through which the sprayer can be driven. These spaces later may be used as roads when it comes to gathering the crop. In turning the vines a stick somewhat like an ordinary hoe handle is used.

### IRRIGATION OF THE FIELD CROP

Cucumbers are grown under irrigation in the western irrigated districts, but the greater part of the commercial crop of the Eastern and Southern States is produced without irrigation. There are times, however, throughout the region of natural rainfall when irrigation would prove a decided advantage and greatly prolong the picking season. During periods of drought, when the field-grown cucumber crop is suffering because of lack of moisture and prices of good stock are high, irrigation will frequently pay. Many growers are now planting at least a part of their acreage either under overhead irrigation or on land that is subirrigated. Although the question of cost is the determining factor, the tendency is more and more toward the provision of all necessary conditions for making a high-grade crop. The results obtained by the sash-cucumber growers are due largely to their ability to control moisture conditions, thus prolonging the picking season and at the same time keeping up the quality. Being shallow-rooted, the cucumber quickly suffers either from the lack of moisture in the soil or from an excess of it. Overwatering should be avoided; short but rather frequent applications of water should be made. It naturally follows that the grower who has irrigation facilities will reap the benefits during the seasons of short crops and high prices.

### PLANTING THE COLDFRAME CROP

Cucumbers grown in coldframes are started in greenhouses (fig. 4) and transplanted to the frames, earliness being the main objective. In the Norfolk district the seed is sown about February 24 or 25 in a small bed in a greenhouse heated by pipes buried in the soil 12 or 14 inches apart and about a foot below the surface. Hot water from the greenhouse boiler circulates through these pipes, raising the temperature of the soil to about  $80^{\circ}$  or  $82^{\circ}$  F. The soil is warmed and properly moistened several days in advance of planting the seed. On the appointed date, usually 3 days before March 1, the seeds are sown in drills in this heated bed, covered lightly, and kept properly moistened. In 3 or 4 days the seedlings are ready for transplanting. They are then carefully lifted and placed in 5-inch or 6-inch flowerpots filled with excellent and well-enriched potting soil, seven to nine plants being set in each pot. The pots are then placed on the greenhouse benches, and a temperature of  $65^{\circ}$  to  $80^{\circ}$  is maintained in the house, with proper ventilation, during a period of about 4 weeks. In the meantime the plants are thinned, first to four or five in a pot and

later to three. At the end of 4 weeks under proper management the plants will have formed three to five true leaves, as shown in figure 5, and will begin to crowd, making it necessary to separate the pots 2 to 3 inches on the greenhouse benches. Contrary to the general belief



FIGURE 4.—Type of greenhouse used for growing early cucumber plants for setting in coldframes. Note in the foreground the stack of flowerpots in which the plants are grown.

that cucumbers cannot be readily transplanted, the sash-cucumber growers of the Norfolk district have been following this practice successfully for many years.

During the time that the plants are being grown in the greenhouse the coldframes are prepared for the transfer of the plants to them. The frames consist of two parallel lines of boards 6 feet apart, a 1- by 12-inch board at the north side and a 1- by 6-inch board at the south side, set on edge and fastened to stakes. The sash simply rest upon these boards, no crosspieces being provided. In preparing the beds for planting, a deep, broad furrow is opened through the center and partly filled with well-rotted manure. The manure is then mixed with the soil in the bottom of the furrow, the soil turned back over the manure, and the surface harrowed, leaving a slight depression or broad furrow through the center of the bed. The sash are then placed on the frames and the beds allowed to become warm from the heat of the sun. In setting the plants in the beds the pots containing them are taken to the frame yard and the ball of earth is carefully jarred loose from the pot and set in the bed, one hill directly under the center of each sash. As the plants are set they are watered, the sash is replaced, and careful attention is given to the ventilation, also to protecting the plants from cold drafts and severe wind until they become well established.



FIGURE 5.—Greenhouse-grown cucumber plants ready to be set in coldframes.

## MANAGEMENT OF COLDFRAMES

### TEMPERATURE CONTROL

Temperature control of the beds is very important, and although a maximum of 85° F. is permissible, care must be taken to provide ventilation to prevent overheating. Ventilation is obtained by propping up the sash, always on the side opposite the wind, 4, 6, or 12 inches as required, by means of small notched boards, as shown in figure 6. The passing of a small cloud on a bright but chilly day will frequently reduce the temperature in the beds 10° to 20° and will require that the sash be lowered, but with the return of the sunshine the sash should again be raised. The more successful sash-cucumber growers keep a man stationed on each acre of cucumbers during daylight hours, his main duty being to watch the thermometers in the beds

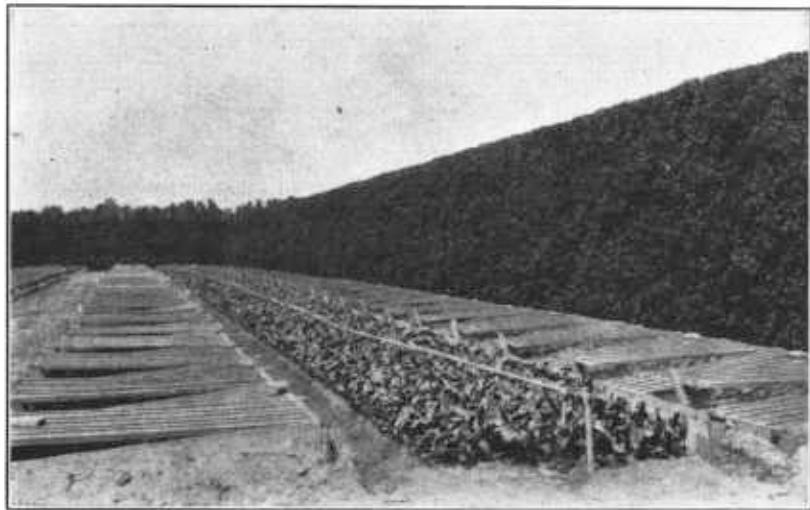


FIGURE 6.—Cucumber frames with a crop of early beets in the spaces between the frames. Originally over the beets, these frames were simply moved over for the cucumbers. The method of ventilating the frames is also shown.

and to regulate the temperature. Night temperatures are controlled to a considerable extent by closing the beds early in the evening and, in extreme cases, placing a thin layer of straw or marsh hay over the glass.

### WATERING IN COLDFRAMES

Watering coldframe-grown cucumbers is almost as important as temperature control, but its frequency depends upon weather conditions. If the weather is cloudy, very little watering will be required; on the other hand, if the weather is bright and there is considerable wind, watering will be necessary two or three times a week. Water is applied with a 1-inch hose, usually in the morning when the temperature is rising; a man and a boy work together, the boy going ahead raising the sash and propping each about a foot high, while the man does the watering. The beds are then closed immediately unless the temperature is such as to require their being left open.

The quantity of water will depend upon the condition of the soil. The water is applied in a soft stream from a hose without a nozzle, the stream sometimes being spread by holding the thumb or finger lightly over the end of the hose. The precaution should always be taken to apply the water to the soil without greatly washing or injuring the plants. After the removal of the sash and frames, water is applied by means of lines of sprinkler pipe supported on stakes about 24 inches above the ground.

### CULTIVATION IN COLDFRAMES

Cucumbers grown in frames are cultivated and fed with fertilizer from the very start. The plants are hand-hoed about once a week until the vines completely fill the 6-foot beds. After all danger of cold weather is past the sash are removed and stored in sheds, and the

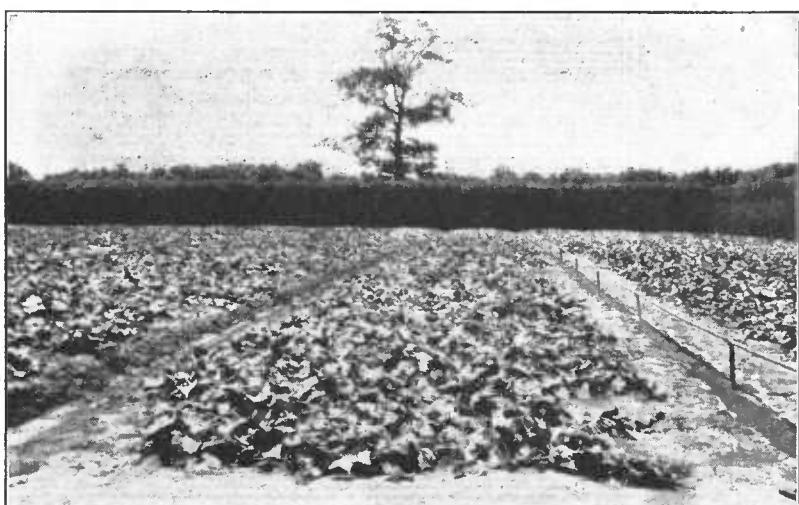


FIGURE 7.—Frame-grown cucumbers in the Norfolk, Va., district. Photographed in the same location on June 14, 30 days later than those shown in figure 6. Note the windbreak of California privet growing to a height of 12 or 14 feet.

board sides of the frames are taken away. The 6-inch board at the south side of the frame is first removed, the 12-inch board being left at the north side for protection. Later this is also taken away, the vines are turned slightly, and the soil is cultivated under them. The vines are again spread and allowed to occupy the entire area between the beds, as shown in figure 7. Large quantities of cucumbers are often marketed from the frames before the removal of the sash, but the heaviest pickings occur about the middle of June, after both the sash and the frames have been removed.

### POLLINATION OF CUCUMBERS IN COLDFRAMES

Pollination, or the setting of fruit, on cucumber vines is dependent upon some outside agency such as bees. Two kinds of flowers are

found on every fruiting cucumber plant—the male ones (fig. 8), which supply the pollen, and the female ones (fig. 9), which produce the cucumbers. They can be readily distinguished, as the female flower is borne on the outer end of the little cucumber. Usually the male flowers appear in great abundance in advance of the female flowers, which leads to the erroneous notion that the cucumbers are failing to set fruit. Later, the female flowers appear, and fruit is formed. Cucumbers grown in the field are pollinated by either tame or wild bees from the neighborhood. Under favorable conditions, cucumbers grown in frames may be pollinated by natural agencies, but the sash-cucumber growers of the Norfolk district provide hives of bees near their frames when the cucumbers are setting, in order to insure perfect pollination. Without proper pollination the cucumbers are deformed, or at least a considerable percentage of nubbins are produced. In localities where bees are scarce it is ad-



FIGURE 8.—The male or staminate flower of cucumber.

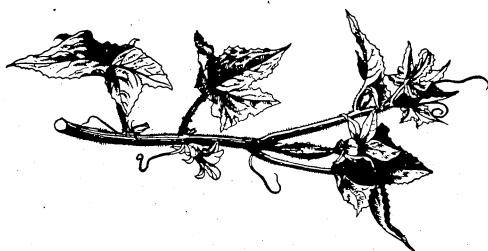


FIGURE 9.—The female or pistillate flower of cucumber.

visible for the growers of cucumbers in fields to keep bees, in order to insure pollination.

## INSECT ENEMIES AND THEIR CONTROL<sup>1</sup>

### CUCUMBER BEETLES

Of the insects that attack the cucumber crop, the striped and the spotted cucumber beetles are the most troublesome. Generally the striped cucumber beetle (*Diabrotica vittata* (F.)) is the more abundant and injurious, but in some districts attacks by the spotted cucumber beetle (*Diabrotica duodecimpunctata* (F.)) are a serious menace to the successful growth of cucumbers during the early part of the season.

The first of the striped cucumber beetles to emerge from their winter quarters late in the spring frequently attack and kill the seedling cucumbers as they are breaking through the ground. Throughout the summer the beetles chew on the leaves and tender shoots and often girdle the stems of the plants near the soil surface. The larvae, or "worm" stage, of this beetle also damage cucumbers by feeding upon the roots and tunneling through the underground stems. Furthermore, the beetles are known to spread bacteria that often

<sup>1</sup> Prepared in the Division of Truck Crop and Garden Insect Investigations, Bureau of Entomology and Plant Quarantine. For further information on the control of insects injurious to the cucumber crop, write to the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, Washington, D. C.

cause the cucumbers to wilt and die. Control measures to protect the crop effectively from damage by these beetles must be prompt. In some districts as many as 3 to 10 applications of insecticides may be necessary.

Where the acreage is small the hills of cucumbers may be covered, as soon as the plants appear above the ground, with cones of wire- or cloth-screen protectors. Such covers will provide protection from beetle damage during the early stages of plant growth. Soil should be banked around the protector at its base so as to prevent possible entry by the beetles. Planting an excess of seed and thinning out after the plants have started is also a help in reducing the effects of damage by the beetles. When it is necessary to use insecticidal dusts the plants should be well covered with the dust from the time they appear above the ground until danger of insect attack is past.

**All dusts and other compounds recommended for the control of beetles and other pests are more or less poisonous. Do not attempt to apply them without reading the cautions on pages 15 and 18.**

Calcium arsenate and gypsum mixed at the rate of 1 pound of the calcium arsenate to 9 pounds of gypsum is a useful dust. This dust should be applied with hand-operated dusters so as to entirely cover all parts of the cucumber foliage.

The effectiveness of the calcium arsenate dust can be increased by including copper oxychloride or another "insoluble" copper compound in the mixture. One formula that has been found satisfactory is as follows:

Calcium arsenate-----	20 pounds.
Copper oxychloride (containing 25 percent of "insoluble" copper)-----	12 pounds.
Talc-----	68 pounds.

Synthetic cryolite and talc mixed at the rate of 1 pound of the cryolite to 4 pounds of talc is also effective against the beetles. Application of this dust mixture should be similar to that described for the calcium arsenate mixture.

A derris-dust mixture containing 0.75 to 1 percent of rotenone with talc or clay as the diluent is an effective remedy when applied to the beetles gathered on the plants. This dust may be purchased already prepared, or it may be home-mixed. To prepare a dust containing 0.75 percent of rotenone, use the following formula:

Derris (4-percent rotenone content)-----	18½ pounds.
Talc (or other diluent)-----	81¼ pounds.

The use of a rotenone-bearing spray containing a sticker also has been found effective against the beetles. The following formula may be used for preparing a suitable spray mixture:

Derris (4-percent rotenone content)-----	4 pounds.
Skimmed milk powder-----	2 pounds.
Water-----	100 gallons.

An impregnated pyrethrum dust containing 0.2 to 0.5 percent pyrethrins may also be used effectively against the beetles.

Bordeaux mixture with calcium arsenate added drives away beetles and prevents injury to the leaves so treated. Under some conditions, however, bordeaux mixture has been noted as causing slight damage to cucumber foliage.

**Caution.**—Special care should be exercised in handling, mixing, or applying poisonous insecticides so that quantities of the dust are not inhaled. Well-designed respirators affording protection to the entire face are available and should be used when such danger exists. In addition, the hands or any exposed parts of the body should be washed thoroughly after working with insecticides. Sprays or dusts containing arsenicals, cryolite, or other poisonous chemicals of a stable nature should not be applied to the crop when fruits that will be marketed or eaten are on the plant unless the residue can be removed by washing or stripping. All these poisonous materials should be applied as sparingly as is consistent with the control of the insect. In dusting, every effort should be made to obtain a light, even coating and to avoid excess application, such as frequently results from sprinkling the poison on the plant from a perforated can or sack. Early applications will frequently make it unnecessary to apply control measures late in the development of the plant.

Information regarding the purchase of insecticide materials may be obtained through local dealers in agricultural supplies, seedsmen, general stores, drug stores, and department stores, or from the county agricultural agent, the State agricultural experiment station, or the State department of agriculture.

#### MELON APHID

Cucumbers are frequently attacked by the melon aphid (*Aphis gossypii* (Glov.)), a small louselike insect that obtains its food by sucking the plant juices. It feeds mostly on the under side of the leaves and, when abundant, causes the leaves to curl, lose color, and finally die. These insects start in the early part of the season as small colonies on the under side of the leaves, and, unless checked, they soon spread over the entire field. They are also carriers of certain diseases from one plant to another.

Dusting the plants with 2-percent nicotine dust is perhaps the most effective method of controlling this pest. For best results the dust should be applied at the rate of 30 to 50 pounds per acre when there is no wind, when the air temperature is above 70° F., and when the plants are dry. Hand dusters may be used in applying the dust to small areas before the aphids have spread to all parts of the field; but if the infestation has become general and the infested areas are large, power or traction dusters should be used. The dust should be directed to the under side of the leaves.

Spraying with nicotine sulfate to control the aphids on cucumber plants has been found effective, but it is more difficult to reach the under side of the leaves with a spray than with a dust. In instances of heavy infestation the cucumber vines should be turned by hand so

as more effectively to hit the aphids with the spray. The spray solution is made as follows:

Nicotine sulfate (40 percent nicotine) - - -	$\frac{3}{8}$ pint (or 6 fluid ounces).
Soap (laundry or fish-oil soap) - - - - -	2 to 4 pounds.
Water - - - - -	50 gallons.

For small quantities, make solution as follows:

Nicotine sulfate (40 percent nicotine) - - -	1 teaspoonful.
Soap (laundry or fish-oil soap) - - - - -	1 ounce (1-inch cube).
Water - - - - -	1 gallon.

### MELONWORM AND PICKLEWORM

Two species of worms, known as the melonworm (*Diaphania hyalinata* (L.)) and pickleworm (*Diaphania nitidalis* (Stoll)), commonly attack the fruits of cucumbers, especially in the South. These worms vary from white to light green in color and are about three-fourths of an inch long when fully grown. The pickleworm is destructive mainly to the fruit of the cucumber. It eats cavities or channels in the rind or bores into the interior of the fruit. Only rarely does it attack the foliage of cucumbers, but it attacks the fruit, vines, and blossoms. The melonworm, particularly during the early part of the summer, attacks the cucumber foliage and bores into the fruit. The application of derris or cube dust as well as nicotine has given some promise of controlling these pests. Consult your State extension entomologist or your county agent for the most recent information on the control measures recommended against the melonworm and the pickleworm.

### DISEASES AND THEIR CONTROL<sup>2</sup>

Cucumbers are subject to a number of diseases that may be avoided by planting on clean land, or the losses caused by such diseases may be reduced by seed treatment, spraying, or other means. Bacterial wilt, mosaic, angular leaf spot, downy mildew, anthracnose, scab, and root knot are fairly common and sometimes serious diseases that the grower should learn to recognize and control. In the Northern States the most important cucumber diseases are bacterial wilt, mosaic, and anthracnose, and in certain localities and in moist, cool seasons, scab. Under southern conditions downy mildew, angular leaf spot, root knot, and anthracnose are generally the most common and severe.

Cucumbers should not be planted in or adjacent to land where diseased cucumber, muskmelon, or watermelon crops were grown the previous year, because the causal organisms of several of these diseases live over winter in the soil.

### DAMPING-OFF

Damping-off of cucumber seedlings is characterized by a shriveling and water soaking of the stems at the ground line that cause a sudden collapse and death of the young plants. This trouble is caused by various fungi that are common in the soil and is most severe during periods of cool, wet weather. Damping-off can usually be satisfactorily controlled by dusting the seed with red copper oxide dust just before

<sup>2</sup> Prepared by the late W. W. Gilbert, senior pathologist, and S. P. Doolittle, senior pathologist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry.

planting. The dust is used at the rate of about 1 level teaspoonful of dust to 1 pound of seed or, if large quantities of seed are to be dusted, at the rate of 1 pound of dust to 100 pounds of seed. The dust and seed are shaken together in a closed container to insure thorough coating of the seed, and the excess dust is screened off. This treatment does not take the place of the 1 to 1,000 mercuric chloride treatment described on page 18 for the control of angular leaf spot and other diseases. The best plan is to treat the seed with mercuric chloride some time before planting and then apply the red copper oxide just before the seed is planted.

#### BACTERIAL WILT

Bacterial wilt, caused by *Erwinia tracheiphila* (E. F. Smith) Holland, affects cucumbers, muskmelons, and squash. The first symptoms consist of the drooping of a few leaves, followed by the gradual wilting and death of the plant. This wilting is due to bacteria that

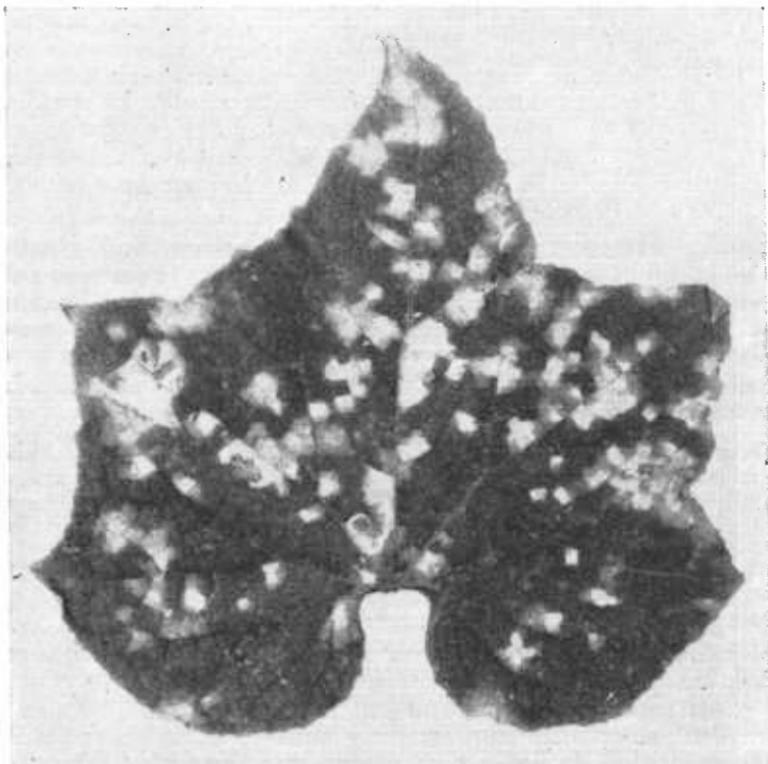


FIGURE 10.—Cucumber leaf affected by angular leaf spot. Note that the older spots have been torn out, leaving holes in the leaf.

enter the water vessels of the stem and cause clogging and injury, which eventually kill the plant. The bacteria do not live in the soil or seed but are carried over winter by the striped and the spotted cucumber beetles, which also spread the disease in feeding by carrying the bacteria on their mouth parts from diseased to healthy plants.

An effective means of control consists in dusting with the calcium arsenate-copper oxychloride-talc dust described on page 14. This mixture is particularly valuable since it also furnishes protection against leaf diseases. A 2-4-50 bordeaux mixture (p. 20) with the addition of 2 pounds of calcium arsenate also serves the same purpose but is somewhat injurious to young plants. In small plantings the removal and destruction of wilted plants is an aid in control.

**Caution.**—Bordeaux mixture may cause gastric disturbances if taken internally; all unused portions should be disposed of or covered, in order to be inaccessible to children and animals. It is also somewhat irritative to the eyes and skin.

#### ANGULAR LEAF SPOT

Angular leaf spot, caused by *Phytoponas lachrymans* (Smith and Bryan) Bergey et al., is a bacterial disease that produces small water-soaked spots on the leaf. Later these dry, turn gray, and often tear out (fig. 10). The disease also affects the fruit, on which it causes small circular, water-soaked spots, which may crack open and permit soft rot organisms to enter. The bacteria are carried both on the seed and in the soil. The best control consists in seed treatment combined with crop rotation. Seed should be treated by soaking for 5 minutes in a 1 to 1,000 solution of mercuric chloride (corrosive sublimate) and then should be rinsed thoroughly in water before drying. The solution should be prepared only in wooden or earthenware containers, as it corrodes metal vessels.

**Caution.**—Mercuric chloride is a deadly poison, and great care must be taken in mixing and handling the solution to prevent contact with the mouth, eyes, and nostrils. After the solution has been used, all that remains should be buried or disposed of in a safe manner. Oiled leather gloves should be worn if much of the solution is to be handled. The hands should be washed after using the chemical, and all vessels should be cleaned thoroughly after use.

Spraying or dusting with copper fungicides is also of some value in the control of angular leaf spot.

#### ANTHRACNOSE

Anthracnose is caused by a fungus (*Colletotrichum lagenarium* (Pass.) Ell. and Halst.), which, like the bacterium causing angular leaf spot, is carried on the seed and in the soil. It produces light-brown, roundish spots that dry out and tear from the leaf (fig. 11). When severely affected, the plant may be practically defoliated within a comparatively short time. The stem and leaf petioles are attacked also, and mature fruit commonly show slightly sunken, dark-brown to black circular spots that do not extend deeply into the flesh. The control is the same as that for angular leaf spot.

#### DOWNY MILDEW

Downy mildew is a fungus disease caused by *Peronoplasmodara cubensis* (B. and C.) Clint., which is most common in the South but also occurs to some extent in the Middle Atlantic States. It appears in midseason and produces on the leaves yellow irregular spots that

usually appear first on the older foliage. These spots enlarge rapidly and cause the withering of the leaf. In warm, moist weather the disease spreads very rapidly, and in many instances all the older foliage is killed, leaving only the leaves at the top.

Spraying or dusting with a copper fungicide is an effective means of control if the plants are sprayed or dusted regularly throughout the season (p. 20).

#### SCAB

Scab is a fungus disease caused by *Cladosporium cucumerinum* Ell and Arth., which is most common in the Northeastern States and is

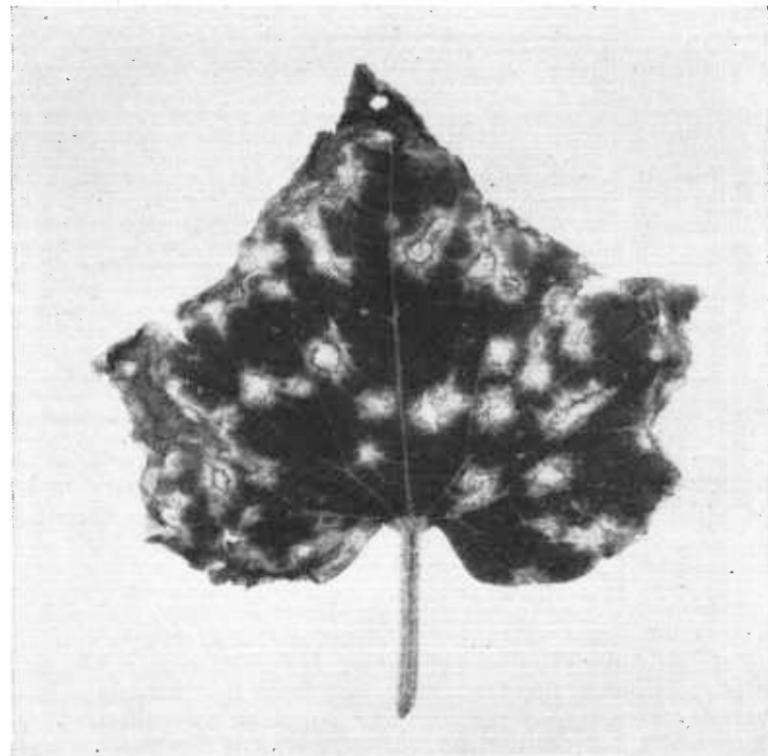


FIGURE 11.—Cucumber leaf showing spots caused by anthracnose. The centers of the spots are light brown with a darker margin.

severe in cool, moist weather. The first symptoms consist of water-soaked spots on the leaves and fruits. On the fruits these spots show a milky, gummy exudate, which is most evident early in the development of the spot. This dries down, and shallow, dry cavities form on the fruit. In moist weather these cavities become covered with a velvety, grayish-olive coating of the fungus spores (fig. 12).

The best control consists in rotation of the crop, since the fungus will live for at least one season on crop refuse in the soil. Too thick planting should be avoided in order to permit rapid drying of the vines after heavy dew or rain. Spraying or dusting with a copper fungicide also is of some value in its control.

## SPRAYING AND DUSTING FOR CONTROL OF LEAF DISEASES

Spraying and dusting are preventive rather than control measures for fungus and bacterial leaf diseases. Successful control is obtained only when the work is started early in the season, before the disease is established, and when it is done thoroughly and with effective equipment. Power machines are necessary if any considerable acreage is to be treated, and it is essential that the plants be covered with the spray or dust. The first application should be made when the plants are small and others at intervals of 5 to 7 days if rains are frequent. In dry seasons, applications every 10 to 12 days may be sufficient.

In the past, bordeaux mixture has commonly been recommended for the control of cucumber diseases, but this material, while very effective in disease control, is somewhat injurious to the plants. More recently there have been used a number of so-called fixed or insoluble

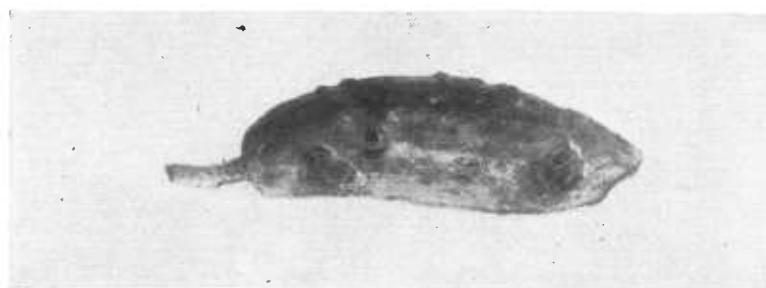


FIGURE 12.—Cucumber fruit spotted by scab. The spots are sunken and covered by a growth of the scab fungus.

copper compounds that are less likely to injure the plant and have proved effective in disease control.

### Bordeaux Mixture

If cucumbers are sprayed with bordeaux mixture, a 2-4-50 mixture should be used. This contains 2 pounds of copper sulfate, 4 pounds of lime, and 50 gallons of water. It can be prepared by making up stock solutions of copper sulfate and fresh hydrated lime in separate barrels, the usual strength being 1 pound to the gallon. To make 100 gallons of a 2-4-50 mixture, three-fourths of the water is put into the spray tank and 4 gallons of copper sulfate stock is added. The solution is then kept agitated and 8 gallons of lime stock is added, after which the tank is filled to the proper level. A finely powdered form of copper sulfate that simplifies mixing is also available. The spray tank is filled three-fourths full of water and agitated while the powdered copper sulfate is added. The lime is made up in a thin paste in water and poured into the tank; after that the remaining water is added. After being mixed, the solution should be used at once.

See precautions on page 18.

**Other Copper Sprays and Dusts**

The so-called fixed or "insoluble" copper preparations include cuprous oxides, copper oxychlorides, and other compounds of copper. These are used as both sprays and dusts and are less injurious to the plant than bordeaux mixture. Most of these materials are commercial preparations, and the copper content varies. An effective spray consists of the equivalent of  $\frac{1}{2}$  pound of copper (calculated as metallic copper) in 50 gallons of water with the addition of 4 pounds of wheat flour as a sticking agent. The dusts can be mixed at home or may be purchased ready-prepared. They are easier to apply than sprays and are effective in disease control. A mixture containing 4 pounds of copper, 15 pounds of wheat flour, and 81 pounds of talc gives good results. In preparing dusts or sprays, the amount of any copper preparation needed can be determined from the percentage of metallic copper it contains, and care should be taken to know the percentage contained in the particular material used. If a compound containing 25 percent of copper is used, 4 pounds are needed to give 1 pound of copper, whereas with one containing 35 percent of copper, about 3 pounds would be necessary.

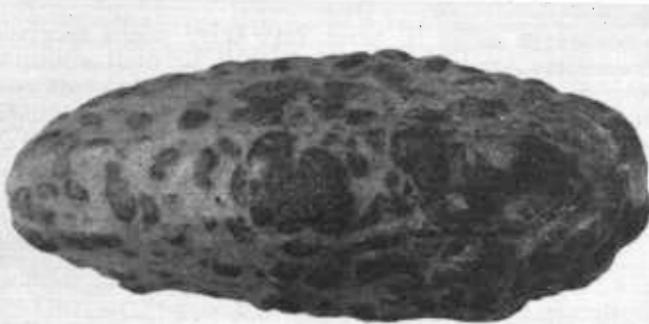


FIGURE 13.—Mosaic diseased cucumber fruit showing dark-green, warty swellings on the surface.

**MOSAIC**

Mosaic occurs on cucumbers in many localities throughout the country, frequently causing heavy losses. It causes green and yellow mottling and wrinkling of the leaves, mottling and wartiness of the fruit (fig. 13), and general dwarfing of the plant. The disease is caused by a virus that is present in the juices of plants affected by mosaic and is transmitted by any means that brings even a minute amount of the juice from a mosaic-diseased plant in contact with a slight wound in a healthy plant. Mosaic is spread by insects, chiefly by aphids and the striped cucumber beetle, which in feeding carry the virus from diseased to healthy plants. It is also transmitted to some extent in picking the fruit and in handling the vines. Mosaic affects other cultivated plants, such as muskmelon, squash, pepper, and celery, and it also attacks a number of weeds and wild plants. Certain wild perennials, such as milkweed and groundherry, carry the virus over winter, and in the spring it is spread from these plants to the

cucumber by insects. It is also carried in the seed of the common wild cucumber, and the cultivated cucumber may be infected from this wild plant. The virus is rarely carried in the seed of the cultivated cucumber and does not live over in the soil.

The best method of combating this disease consists in clean cultivation and the eradication of perennial weeds in and near the fields, combined with rigid insect control (see p. 13). The Shamrock cucumber, originally developed as a mosaic-resistant variety by the Iowa Agricultural Experiment Station, possesses considerable resistance.

#### ROOT KNOT

Root knot is caused by minute nematodes, or eelworms, that attack the roots of cucumbers and many other farm crops and produce swellings or galls. Dwarfing and death of the plants result, and yields are often much reduced. This trouble is frequently very serious in the sandy soils of the South, but is rarely of importance in the North. Crop rotation and planting cucumbers only on land free from nematodes are the best methods of control now known.

#### GATHERING AND PACKING

Table cucumbers must be fresh and crisp when received by the consumer, and the trade prefers that they be of medium size, well-formed, and of a dark-green color over at least two-thirds of their length. Too much stress cannot be placed upon the necessity for frequent gathering of the cucumbers and their prompt handling after they are gathered. Careful handling is also essential in order to avoid bruising. Cucumbers that are gathered after a rain or in the morning while the dew is on them are liable to be dirty and discolored. All sand or dirt should be either washed or brushed from the surface. Rubbing with a cloth to remove dirt is objectionable as it removes the small spines and the frosty finish of the fresh cucumbers. The best method of washing cucumbers is to dump the field baskets into a deep tank of clean, cold water through which a fresh stream of water is kept running. Slight stirring of the cucumbers in the tank will usually remove all dirt, but in extreme cases soft brushes are used.

Sash-grown cucumbers are generally gathered every other day, the individual cucumbers being cut from the vines, placed in baskets, and carried or hauled on a low-wheeled wagon or on a small truck to the packing house, where they are washed in a tank of clean, cold water and then spread on a slatted table to drain.

The cucumbers are graded into fancy, choice, and culls. The first two grades are then packed carefully in 28-quart hampers, the cucumbers being laid flat and the top of the hamper faced.

The sash-cucumber growers in the Norfolk district grade and pack according to rules adopted by the Norfolk Hothouse Growers' Association and have the pack inspected. An attractive cardboard cover, which bears the association label and trade-mark, is placed on top of the cucumbers beneath the lid. The grower's number and the grade are stamped on each package.

Most sash-grown cucumbers are shipped in refrigerator cars and trucks, about 600 hampers constituting a carload. Only the fancy and choice are shipped; the culls are sold locally.

Field-grown cucumbers are gathered as often as necessary to prevent their becoming too large or overripe. During the height of the season this will require going over the vines every day; in fact, the gathering of the cucumbers becomes practically a continuous process. As the cucumbers are cut or clipped from the vines they are usually placed directly in hampers or in field baskets, in which they are transported either to the ends of the rows (fig. 14), where they are repacked, or to the packing house. The cucumbers are sometimes gathered in bags slung over the shoulders of the workers, but bags are not so satisfactory for handling the cucumbers in the field as are the 1-bushel baskets or hampers. Splint baskets and rough crates should not be used for gathering the crop, on account of injury to the tender surface of the cucumbers.

A stick with a crosspiece about 1 foot in length nailed to its end is frequently used for turning the vines to locate the cucumbers; it has the double advantage of saving the operator from excessive stooping



FIGURE 14.—Cucumbers gathered in baskets and carried to the ends of the rows.  
(Photographed near Meggett, S. C.)

and serving as a protection against poisonous snakes in localities where they are found.

In certain sections field-grown cucumbers are packed in the field, being graded either as they are gathered from the vines or, more often, at the ends of the rows or at a temporary packing shed located in the field. In some instances they are hauled to the shelter of a large tree (fig. 15), where the grading and packing are done. In a great many sections the cucumbers are hauled to a centralized packing shed, where they are washed, graded, and packed in a careful manner. Belt graders are sometimes used in the centralized packing house, but as a rule the cucumbers are simply graded by hand over tables and packed directly into the hampers. For low cost of handling, however, packing in the field is considered most desirable, although a better grade and pack can be secured in a central packing house.

Packers and shippers of fancy cucumbers have adopted a system of applying a special wax coating to the washed cucumbers to prevent loss of moisture and to maintain a fresh appearance on the market. This wax is sold and applied under a patent and is the same as that being used for other vegetables. Its application adds slightly to the cost of preparing the cucumbers for market but very materially prevents shrinkage and loss of freshness during the shipping and marketing of the product. This wax is not injurious to health.

The United States standard grades for slicing cucumbers as established by the Agricultural Marketing Service are now used by many individual growers and growers' associations. These rules are modified or amended from time to time to suit changed conditions.



FIGURE 15.—Packing cucumbers for the market under the shade of a giant live oak near Meggett, S. C.

### LOADING AND SHIPPING

Field-packed cucumbers are generally hauled to the shipping point and loaded directly into the cars. Where the packing is done in a central packing shed, located on a railroad siding, the hampers of cucumbers are loaded directly into cars as they are packed. In any event, the packages should be removed from the field as quickly as possible after being packed, to avoid exposure of their contents to sun and wind. If the pickers do the grading it is customary to have one man follow behind each gang of pickers to fasten the lids upon the hampers and mark the grade on each package with a rubber stamp. To facilitate these operations, the nails, hatchet, stamp, and ink pad are carried in a tray having a convenient handle. As a rule the lids are distributed by a boy ahead of the man who does the "lidding." The truck or wagon for hauling follows closely behind and loads the hampers within a short time after they are packed. When once upon the wagon or truck the cucumbers can be protected from the sun and wind by a canvas cover. Usually the distance to the loading point is short,

making it unnecessary to cover the load during the trip; but where the crop is hauled direct from the field to market by truck it is essential that the load be well protected by such a cover.

Certain definite rules as laid down by the carriers are observed in loading the hampers of cucumbers in the cars. The main essential for good loading is that the hampers be so placed that they cannot shift in transit. The method of shipment, whether under refrigeration or merely under ventilation, will depend upon the time of the year and the distance to market. As a rule, when the weather is reasonably cool and the shipment will reach the market within 36 hours it is not necessary to ship under refrigeration, but during warm periods and for long hauls shipment in refrigerator cars with bunker icing is essential. Where the cucumbers are sold f. o. b. shipping point, the question of method of shipment is left to the buyer, but where the goods are consigned or sold on delivery the method of shipping should conform to the wishes of the commission house or buyer receiving them.